Enzymes at Work in YOU

*Pat Riot and Steve Nason were headed to Chipotle for lunch one Saturday. It was a beautiful fall day and they had just finished up the second six-week grading period and a test on photosynthesis and cellular respiration.*

Pat: Wow Steven! I’ve just been reflecting on everything we’ve been learning in Biology this year. We have been diving deep into a lot of topics related to the characteristics of life.

Steven: I agree Pat! If we keep up this pace for gaining new knowledge we could be future Jeopardy champs for sure. Although, I’d settle for being a more educated citizen.

Pat: You know one thing I’m surprised we didn’t get into with our last unit on energy was how the body breaks our food to use it in cellular respiration. I got the idea that we convert glucose into ATP, but how does our body get our food broken down?

Steve: Great question Pat! I was curious about the same thing so I read ahead in our textbook. Mrs. Lisius kept hinting that we would be learning about enzymes next so I wanted to know what they were. I searched around in the book and I found the information back in chapter 2. Our book related it to the macromolecules in the Chemistry of Life chapter.

Pat: Oh, I remember those. Those were the major molecules that living things use. Weren’t they carbohydrates, lipids, proteins, and nucleic acids?

Steve: Yep, those were the four that we learned about. Anyways, in that chapter it says that if left to their own devices chemical reactions in our bodies would be too slow and we would suffer. Instead they all need the help of something called a catalyst.

Pat: Oh, I’ve heard that word before, like in catalytic converter, isn’t a catalyst something that accelerates something else?

Steve: (*Excitedly* )You are right on Pat!A catalyst in Biology is something that speeds up a chemical reaction. They work by lowering the activation energy in a reaction.

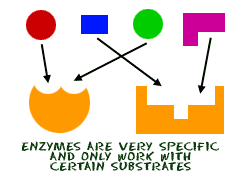
Pat: I think I remember seeing a graph that showed the energy over the course of a reaction. What would the enzyme do to that energy?

Steve: The enzyme lowers the activation energy so there isn’t as much energy needed for the reaction to occur.

Pat: Ah, that makes sense. Now, what is an enzyme really?

Steve: An enzyme is a protein that speeds up the chemical reactions that take place in cells. Each enzyme usually only works on one chemical reaction in the body. Kind of like how only one key fits a certain lock. One example of a reaction in our bodies is in our blood, carbon dioxide is joined with water to make carbonic acid. Without enzymes this is a really slow reaction in fact it so slow that it could lead to dangerous levels of carbon dioxide. One type of enzymatic reaction relevant to our current studies, is our food acted on by enzymes to help it begin its chemical break down.

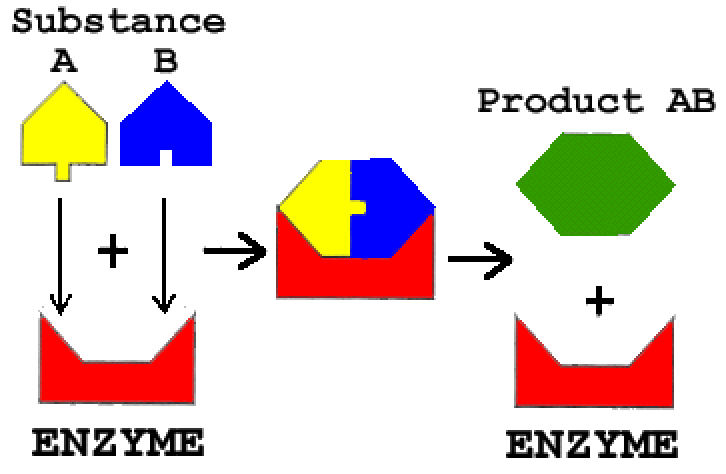
Pat: Wow, sounds like something else I should thank my body for knowing how to do on its own.

Steve: Yep. I’ll make sure to add that to my list of things to be thankful for at Thanksgiving this year. This class is constantly giving me new things to be thankful for. Yet again our bodies are pretty amazing for the way they work.

Pat: Tell me more about this lock and key idea. Are there some key vocabulary words that are used to describe how enzymes fit?

Steve: Of course! Enzymes “work” on something called a substrate. After the reaction that substrate becomes a product. A product could be the splitting apart of a substrate or the joining together of two substrates. The enzyme and substrate join together at the active site.

Pat: So really the only words I need to know are: enzyme, substrate, active site, and product?

Steve: If you can remember, catalyst, then those other four are really the only other ones needed to describe how an enzyme works. You do need to know that the enzyme does not change. The enzyme can actually go and continue to react with other substrates. I like to think of enzymes like a stapler: 1. Enzymes are specific - they only do one job. (I only use a stapler for stapling ... nothing else.) 2. Enzymes can be used over and over again. (Staplers can be used over and over. They aren't one-use tools.) 3. Enzymes are not changed during the reaction they catalyze. (The stapler isn't changed by use, but the papers are changed.)

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Pat: I like the stapler analogy.

Steve: One other clever thing that scientists did is they gave enzymes easily recognizable names.

Pat: Please continue.

Steve: Well, scientists named the specific enzymes after the substrate they work on. The way to recognize an enzyme is it has an ending of –ase. For example lactase is the enzyme that breaks down the milk sugar, lactose and sucrase catalyzes sucrose.

Pat: That was pretty smart for those scientists to do. So I’m guessing that lipase breaks down lipids and protease breaks down proteins?

Steve: That is right. The only one of the macromolecules that has a strange enzyme name is amylase, which breaks down starch into sugars.

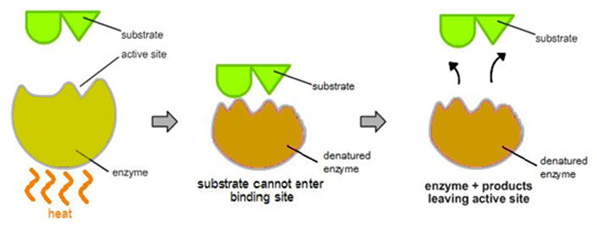
Pat: Oh, that is a strange one, I’m going to remember it though because of that girl at school Amy who just broke up with Lance over some starchy pasta that he gave her for a gift.

Steve: She just didn’t appreciate the gemelli pasta that he gave her and its twisted double helix shape, like DNA. Poor guy! I bet Mrs. Lisius makes her son eat that pasta shape all of the time. ☺

Pat: *giggles.*

Steve: Back to enzymes, their ability to work can easily be effected by changes in our bodies. Two major things that are bodies always try to keep in balance are pH and temperature.

Pat: You mean when our bodies try to maintain homeostasis.



Steve: Yeah that is the word I was looking for. Well, most enzymes work best at a pH of 7.4, which is fairly neutral. If the pH in our body gets too high the enzyme could be denatured and it won’t work anymore. Here is another new word, denatured. It means that the enzyme changes shape.

Pat: So…the key wouldn’t fit in the lock anymore if the enzyme is denatured.

Steve: Exactly. Denaturing is one way our bodies control enzymes otherwise they would just keep on working. Enzymes can also be affected by temperature. Most of them have an ideal temperature they work at. Most of the time higher temperatures help the enzymes because the substrates are moving faster at higher temperature and they have an easier time finding the enzyme to bind to. However, if the temperature is too high or low, the enzyme could be denatured again.

Pat: Yet again one of the reasons our bodies need to maintain homeostasis.

Steve: I don’t know about you Pat, but all of this talk of energy and chemical reactions is making me hungry for a burrito bowl.

Pat: Yeah, let’s get our munch on so our enzymes can get busy obtaining more energy for us. I’m thinking carnitas with rice, beans, lettuce, cheese, and sour cream would be delisius right now.

Steve: Oh man, you are too much. *Gives light jab to Pat.*

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Enzymes at Work in YOU

Once you and your dialogue partner are done with the reading, complete the following analysis of the reading together. Each of you will need to complete this on your own paper.

1. Name and define **7 key vocabulary words** from this reading. Underline where you got the vocabulary words in the reading with red.

a.

b.

c.

d.

e.

f.

g.

2. Name 5 keys ideas you learned about enzymes. **Write as complete sentences**. Underline where you got the keys ideas in the reading with blue.

a.

b.

c.

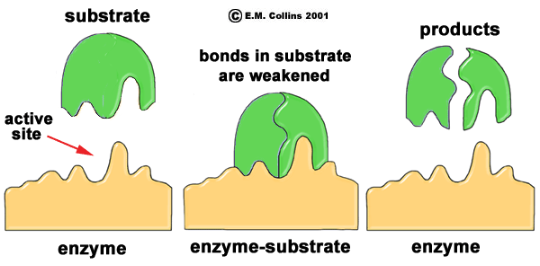
d.

e.

**Enzymes work according to the following equation:**

Substrate + Enzyme Product + Enzyme

3. Label the drawing below with **enzyme, substrate, active site, products,** **before and after.**



1.

2.

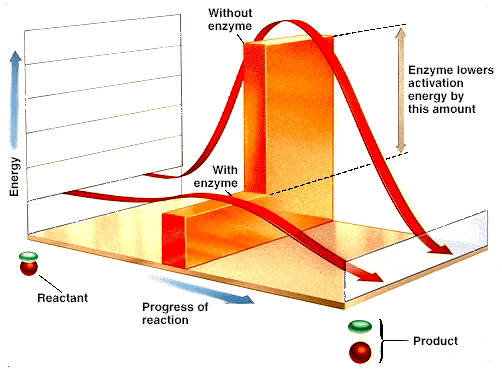
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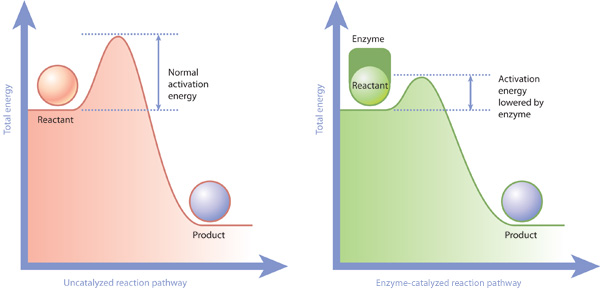
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3.

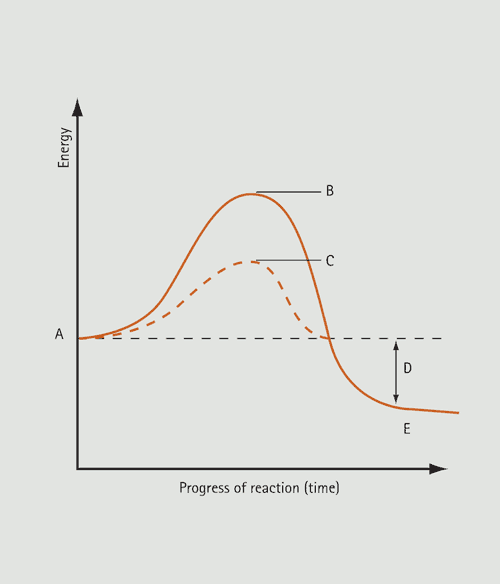
5.

Observe the following energy diagrams and then label the one that follows.





4. Label the energy diagram below with **product, reactant, with enzyme, without enzyme.**

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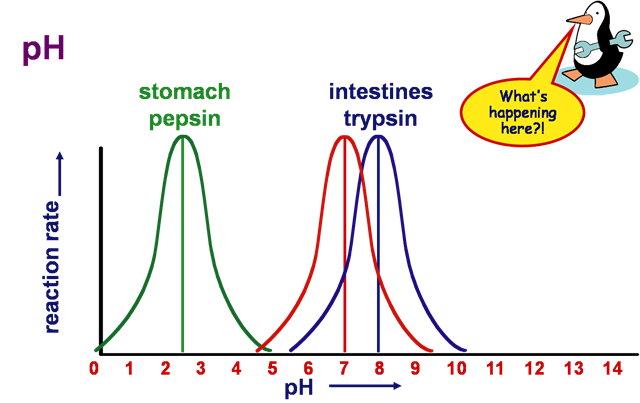
**a.**

**b.**

**c.**

**e.**

5. In the graph below pepsin and trypsin are also enzymes, although they don’t follow the –ase rule, Why are their graphs on the pH scale different? Underline where information about pH’s effect on enzymes is in the dialogue in green. Hint: look at where they are used in the body.

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6. How are enzymes like a lock at key? Underline where this is discussed in the dialogue in yellow.

7. In a 40 word GIST describe your current understanding of enzymes. Make sure to use the key vocabulary you noted above.

